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(54) IMPROVEMENTS IN CARRIAGES FOR AUTOMATIC
RAIL-LESS TRANSPORTATION SYSTEMS

(71) We, BULO PATENT AG, a corporation registered under the laws of Switzerland, of Spielhof 3, 8750 Glarus, Switzerland, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The invention relates to a carriage for an automatic rail-less transportation system incorporating a track of a kind whose presence can be automatically sensed by sensing means on the carriage, which is to travel 15 along the track, so that the carriage is steered along the track under the control of signals from its track sensing means.

Such a transportation system is for example known from Swiss Patent Specification No. 475,895, wherein a carriage is automatically steered along a track in the form of a guide strip. Such a guide strip, for example of iron, is located at the base of the track over which the carriage is to travel. This guide strip is for example inductively sensed by a pair of sensing heads on the carriage which, via a control device, actuate the steering motor of a steering device which operates a pair of steerable 25 wheels. A pair of traction wheels are driven by a separate motor. This type of control requires, however, a costly control and steering device.

The primary object of the present invention is to provide a carriage for an automatic rail-less transportation system which carriage is of comparatively simple and operationally reliable construction and which with the exception of the drive for the traction wheels, incorporates no additional steering device.

Thus according to the invention there is provided a carriage including two laterally spaced traction wheels and track sensing 45 means adapted to sense a track without

contacting the same, for use in an automatic transportation system including a track sensible by said sensing means, said sensing means comprising a central sensing device situated substantially on the longitudinal 50 centre-line of the carriage, and two lateral sensing devices situated one on each side of said centre-line, said central sensing device being operative, upon sensing said track in use, to cause the said traction wheels to rotate at the same speed and each of the said lateral sensing devices being operative, upon sensing the track in use, to cause the said traction wheels to rotate at mutually 60 different speeds, in such manner as to steer the carriage along the track.

Such an arrangement permits a particularly simple design of the carriage because the traction wheels which are in any case necessary for driving the carriage are also used for steering the carriage. The steerable wheels with a steering device and additional steering motor necessary in the known transportation systems mentioned above become completely superfluous with the carriage of the present invention. In addition to the already indicated simple and therefore cheap construction of the carriage the further particular advantage is obtained that the present carriage is much more manoeuvrable than the carriage of such known transportation systems, because the carriage can make practically right-angled turns which is not possible in the known transportation systems. The carriage can also travel both forwards 65 and backwards and is equally manoeuvrable in both directions. This is particularly important if the transportation system is to be used in a building having narrow passages which generally run at right angles to one another and do not permit wide turns. 75

The invention also provides an automatic transportation system comprising at least one carriage as set forth above, and a track sensible by the sensing means of the or each 80 90

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said carriage.

A particularly preferred embodiment of the transportation system incorporating the invention results from the incorporation of a destination control system according to Patent Specification No. 1190211.

Some exemplary embodiments of automatic rail-less transportation systems incorporating the invention will now be described with reference to the accompanying drawings, wherein:—

Fig. 1 is a perspective view of a carriage;

Fig. 2 is a somewhat diagrammatic bottom view of the carriage shown in Fig. 1;

Fig. 3 is a somewhat diagrammatic bottom view of a modified carriage;

Fig. 4 is a fragmentary cross-sectional view taken on the line IV-IV of Fig. 3;

Fig. 5 shows part of a branched track portion in detail;

Fig. 6 is a circuit diagram of the control means, sensing means and the traction wheel drive means of the carriage of Fig. 2;

Fig. 7 shows a modification of the lower portion of the circuit diagram of Fig. 6, adapted for use in a carriage according to Figs. 3 and 4;

Fig. 8 is a more detailed circuit diagram of a sensing device for the system of Fig. 6; and

Fig. 9 is a circuit diagram similar to Fig. 8, for a different sensing device.

Fig. 1 shows a carriage 1 with a chassis 2 supporting a loading platform 3 for goods to be transported. A removable cover 4, here shown to be transparent, overlies the platform 3 to form a receptacle for the goods. As more fully described hereinafter with reference to Fig. 2, carriage 1 has a pair of swivelable rear wheels 5a, 5b and a pair of non-swivelable traction wheels 6a and 6b, only the left-hand wheel 5b, 6b of each pair being visible in Fig. 1. The vehicle is steered by the selective driving of one or both of its two traction wheels, also described in detail hereinbelow. A panel 7 aboard the vehicle carries switches for setting a reading means to a destination code which reacts in a particular manner to code markings which the vehicle is to encounter at various points along its track. This track is defined by a continuous guide strip 17 which differs from the floor 23. The guide strip 17 can be a colour strip but is preferably a metal strip optionally of ferromagnetic material. For sensing the guide strip is used a sensing means 21 (Fig. 2) having sensing devices in the form of a central sensing head 22, a right-hand sensing head 23 and a left-hand sensing head 24. Whilst the right and left sensing heads 23, 24 each have a single sensor 23a, 24a, the central sensing head 22 has two sensors 22a, 22b, arranged at a distance from one another. The sensors project downwardly

from the underside of the vehicle.

The sensing element 11 of a rapid stopping device projects forwardly and is formed from a fluid-filled tube whose deformation upon contact with an obstacle actuates one or both of two pressure switches 12a, 12b to de-activate the wheel drive, as more fully explained in the subsequent description of Fig. 6. Instead of the tube sensing element 11 it is also possible to use other sensing devices such as mechanical sensing elements or those of the echo type, to sense the path for obstacles.

In Fig. 2 is shown a pair of separate drive motors 20a, 20b coupled with the shafts of traction wheels 6a and 6b by speed-reducing transmissions here shown as worm drives 25a, 25b. Also disposed on the underside of the vehicle 1 are a set of reading elements 30, 31, 32, 33, 34, 35 in the form of magnetic switches. These magnetic switches react to corresponding magnetic marking elements of code markings arranged at V-junctions. The junction of the code markings is described hereinafter with reference to Fig. 5. Reading element switches 32, 33 are assumed to have been rendered inoperative by the selective actuation of switches on panel 7 (Fig. 1).

The motors 20a and 20b can be reversible for backward driving, in which case a second sensing means 21' is provided on the rear underside of the carriage. An arrangement of this type is shown in Fig. 3 wherein, furthermore, the traction wheels 6a, 6b are arranged in the centre of the carriage whilst the swivelable idler wheels 5a and 5b of Figs. 1 and 2 are replaced by two longitudinally spaced swivelable wheels 5c and 5d in each half of the carriage. Wheels 6a and 6b are driven, as illustrated in Fig. 4, from a single reversible motor 20 via a speed reducer 25 and a pair of electro-magnetic transmission devices 26a, 26b as well as pairs of chain drives 126a, 126b. The transmission devices 26a and 26b are independently energizable, as described hereinafter with reference to Fig. 7, to complete the power transmission path from motor 20 to traction wheels 6a and/or 6b. These transmission devices may include magnetic clutches as well as magnetic brakes, actuation of one clutch and of the opposite brake affording a more positive steering action.

As shown in Fig. 3 the carriage can have in addition to the front sensing means 21 also a rear sensing means 21' whereby only the sensing means at the front in the direction of travel is connected in. The switching over of the sensing means can take place manually or automatically by a pulse transmitted externally and received by the carriage. Simultaneously with the switching over of the sensing means the motor 20 can be switched over and the rapid stopping de-

vice with the appropriate sensing element in the direction of travel can be connected in.

In Fig. 3 the axis of traction wheels 6a, 6b is at a distance from the sensing means.

5 The reading devices 30-35 are the same as in Fig. 2 but may be supplemented by other reading switches for rearward travel; one such reading element in the form of a magnetic switch, whose specific function will be described hereinafter, is shown at 35'.

10 Fig. 5 shows a portion of the guide strip 17 along with two branch strips 17a and 17b leading to the left and to the right, respectively. At the first V-junction 29a, a set of code markers 130a, 131a and 133a in the form of permanent magnets, substantially level with the floor surface and the strip 17, enable an oncoming vehicle to continue on a straight path along strip 17 or to veer to the left along strip 17a, depending on the setting of the selector switch on panel 7 (Fig. 1). At the second V-junction 29b, a similar array of code markers 130b, 132b and 134b enable an analogous selection between a straight-ahead continuation along strip 17 and a turning to the right along strip 17b. With reading elements 32 and 33 deactivated as described hereinbefore with reference to Fig. 2, the vehicle will move straight at junction 29a (arrow A) and to the right at the junction 29b (arrow B).

It will be noted that the central marker 130a or 130b coincides with the strip 17. This is entirely feasible when the strips consist of nonmagnetic conductive material designed for capacitive sensing as described hereinafter with reference to Fig. 8. In the case of a ferromagnetic strip, designed for inductive pick-up as later described with reference to Fig. 9, all the markers would have to be well spaced from the strip.

As the sensing of the guide strip and the reading of the markers takes place without contact, the sensors and reading elements on the one hand, and the guide strip and magnetic markers, on the other hand, may be covered with a thin protective layer of varnish or the like.

50 The operation of the carriage of Fig. 2 is explained in detail by means of the circuit diagram of Fig. 6 and the path shown in Fig. 5 by arrows A and B. The parts of the carriage in the circuit diagram of Fig. 6 are represented relative to the guide strip 17 when looking down on the carriage.

55 The two motors 20a, 20b are energizable by a source of direct current aboard the carriage, illustrated as a battery 40. A single circuit breaker 12 in series with the ungrounded negative terminal of that source represents the two series-connected switches 12a, 12b of the sensing element 11 of the rapid stopping device of Fig. 1. Upon closure of this circuit breaker, a bus bar 41 carries negative operating voltage to four

signal generators 122a, 122b, 123, 124 of sensing means 21, whereby a signal generator is associated with each of the sensors 22a, 22b, 23a and 24a of sensing heads 22, 23, 24. The nature of these signal generators and the mode of their operation by the sensors will be described later in connection with Figs. 8 and 9. For the present purpose, and as illustrated diagrammatically in Fig. 6, each signal generator is assumed to comprise a normally open switch which closes whenever the corresponding sensor is aligned with the strip 17.

The control means has four relays 222a, 222b, 223 and 224, energizable from bus bar 41 via the respective signal generators 122a, 122b, 123, 124. These relays control the operation of two driving relays 120a, 120b to energize the two drive motors 20a, 20b respectively. If both relays 223 and 224 are concurrently operated, an energizing circuit is completed for both driving relays 120a and 120b via the upper armatures and front contacts of these sensing relays, upper armature and back contact of test relay 223 in the case of driving relay 120a, and lower armature and back contact of test relay 224 in the case of driving relay 120b. The upper armature and back contact of relay 223 are normally shunted by the other right-hand armature and back contact of a control relay 220a; similarly, the lower armature and back contact of relay 224 are normally shunted by the outer left-hand armature and back contact of a control relay 220b. The working contacts of the armatures of relays 120a and 120b are connected to bus bar 41 via a potentiometer 42 whose slider may be adjusted for equalizing the torque exerted by the two driving motors 20a, 20b upon the respective traction wheels 6a, 6b (Fig. 2) so as to ensure travel on a straight course.

Control relays 220a and 220b are energizable upon the concurrent closure of magnetic switches 30, 34 and 30, 33, respectively. Closure of any of magnetic switches 31, 32, 35 simultaneously with switch 30 operates a further control relay 220c whose armatures and back contacts are connected in respective holding circuits for relays 220a and 220b. The first of these holding circuits extends from the winding of relay 220a via its outer left-hand armature and rest contact, lower rest contact and armature of relay 220c, and inner left-hand armature and rest contact of relay 220b to bus bar 41; the second holding circuit extends to this bus bar 41; the second holding circuit extends to this bus bar from the winding of relay 220b by way of its outer right-hand armature and working contact, upper armature and rest contact of relay 220c, and inner right-hand armature and rest contact of relay 220a. Thus, each of relays 220a and 130

220b can lock only when neither the opposite control relay 220b, 220a nor the "straightahead" relay 220c is operated.

The width of the guide strip 17 should be so chosen that, whenever the vehicle veers sufficiently off course to either side to disalign either or both central sensors 22a, 22b of central sensing head 22 with that strip, one of the lateral sensors 23a, 24a of the lateral sensing heads 23, 24 finds itself in registry with the strip to generate a corrective signal. This will always be the case if the strip width is substantially equal to the length of a side of the square, preferably a diamond defined by the sensors 22a, 22b, 23a, 24a. Since, however, the vehicle is not expected to swerve sharply from its original path, it will generally suffice to make this width equal to about half the transverse diagonal 23a-24a of this sensing arrangement. As the length of the longitudinal diagonal 22a-22b relative to the width of the strip, determines the maximum yawing angle before corrective action occurs, the latter diagonal advantageously is made somewhat longer than the transverse diagonal. Reducing the strip width, furthermore, increases the precision with which the reading element switches 30-35 will line up with the corresponding markers so that the width of the latter may also be reduced.

If, with relays 220a, 220b 220c deenergised, the vehicle deviates from its guide path sufficiently to let one of the central sensors (generally the leading sensor 22a) move off the strip 17, the corresponding relay (e.g. 222a) will be released so that the circuit of relays 120a and 120b is broken. With these relays de-energized, the armature windings of motors 20a and 20b are open-circuited at the inner left-hand armature of relay 220a and the inner right-hand armature of relay 220b, respectively. One of the driving relays, however, is held operated by the substantially concurrent response of one of the lateral sensors, such as sensor 23a if the deviation has been to the left. With signal generator 123 operating the relay 223, an alternative energizing is closed for driving relay 120b from bus bar 41 via the lower armature and working contact of relay 223. Thus, motor 20b remains under power to drive the associated traction wheel 6b while the opposite traction wheel 6a idles; this results in a gradual course correction with the vehicle veering slightly to the right until both central sensors 22a and 22b are again aligned with the strip 17 to restore rectilinear motion.

As the vehicle, traveling on a straight line, passes the junction 29a of Fig. 5 in the direction of arrow A, sensors 22a, 22b and 24a will concurrently respond to the proximity of strips 17 and 17a. The response of sensor 24a excites the relay 224 whose

upper armature and working contact close an energizing circuit for driving relay 120a. Since this relay, along with counter-relay 120b, is already operated via relays 222a and 222b, the presence of branch strip 17a underneath the carriage is without effect. With reading elements switch 31 activated and reading element switch 33 deactivated, relay 220c is momentarily energized by the simultaneous closure of switches 30 and 31 upon the approach to junction 29a to release control relay 220a or 220b if either of them had been previously actuated. On a differently programmed carriage, having reading element switch 33 operative and reading element switch 31 inoperative, relay 220b would have been energized via simultaneously closed switches 30 and 33 on the approach of junction 29a. This relay, which locks over its outer right-hand armature and working contact, would have opened, at its parallel circuit on the outer left-hand armature and rest contact, the relay 223 whereby the latter relay, on being operated by the response of sensor 24a to branched strip 17a, would have broken the energizing circuit of relay 120b notwithstanding the continued operation of relays 222a and 222b. The armature winding of motor 20b would then have been short-circuited by the earthing of its left-hand terminal via the armature and rest contact of relay 120b and the inner right-hand armature and working contact of relay 220b. This would have resulted in the exertion of a braking force upon the left-hand traction wheel 6b, with motor 20a continuing to drive the right-hand wheel 6a; the vehicle would then have turned onto the branch path 17b, its leftward swing being interrupted only momentarily during passage of sensor 23a across the strip 17 with brief reoperation of relay 120b and motor 20b.

As the vehicle with the original switching state (reading element switches 31, 34, 35 as shown in Figs. 2 and 3) approaches the junction 29b along strip 17, reading element switch 34 passes over marker 134b concurrently with the passage of reading element switch 30 over marker 130b so that control relay 220a is actuated. In a manner analogous to that described above with reference to relay 220b, relay 220a causes the de-energization of driving relay 120a as soon as sensor 23a picks up the branch strip 17b whereby motor 20a is braked by the short-circuiting of its armature winding via the armature and rest contact of relay 120a in series with the inner left-hand armature and working contact of relay 220a. With relay 120b remaining operated under the control of sensor 23a, the left-hand traction wheels 6b is powered while the right-hand wheel 6a is braked. The resulting rightward swing, which turns the vehicle onto the

branch path defined by strip 17b, is again momentarily interrupted by a brief re-energization of relay 120a as the sensor 24a detects the forward extension of strip 17; thereafter, if (as is likely) the vehicle has not yet fully aligned itself with the strip 17b so that the front sensor 22a is not above that strip, sensor 23a again takes over the exclusive control of the driving circuit so that motor 20b, alone, remains operated.

With relay 220a locked operated, the steering of the vehicle along strip 17b would proceed in essentially the same fashion as heretofore described with reference to strip 17, except for a sharper corrective action (owing to the braking of motor 20a) whenever it strays off course, to the left of its guide path; a similar situation exists along strip 17a, with regard to rightward deviation, for a vehicle whose relay 220b is energized. To restore the more gradual and symmetrical mode of guidance explained above, therefore beyond each junction a combination of markers 130', 135' and 130'', 135'' are provided to actuate the relay 220c by simultaneous closure of reading element switches 30 and 35 to release the relays 220b and 220a, respectively. If the speed of the carriage in passing over these junctions is low enough, the braking circuits leading over the front contacts of relays 120a and 120b could be omitted, thus eliminating the need for these additional markers on branch paths 17a, 17b. Conversely, the rest contacts of relays 120a and 120b could be permanently earthed if the nondriven drive wheel is to be braked under all circumstances.

When ever the carriage reaches the end of its guide path so that at least the sensors 22a, 23a and 24a are no longer above a guide strip, both motors 20a, 20b are deactivated so that the vehicle comes to a halt. Naturally such stoppage also occurs, if the vehicle is thrown off its course, e.g. on impact with an obstacle.

If the carriage is conditioned for rearward travel, as by operation of a reversing key on the panel 7 of Fig. 1, another set of relays similar to those shown in Fig. 6 take over the control of motors 20a, 20b. Reading element switch 35' may then control the counterpart of relay 220c, in a manner analogous to that of reading element switch 35, upon encountering a marker on its side of the guide strip.

It will be noted that, according to Fig. 5, code markings at junctions 29a and 29b differ from each other by the relative position and spacing of the bar magnets serving as markers. If the number of junctions to be successively traversed by one carriage is small, the control commands to be performed at these junctions can be generated by different groupings of selectively actuatable reading element switches. In a more complex

system a single group of reading element combinations may be selectively activated, at successive junctions, by a programmer aboard the carriage which could be stepped, for example, by each actuation of reading element switch 30 or by the operation of relay 220c upon passage over any branching point.

Fig. 7 shows part of the circuit diagram of Fig. 6, including the control relays 220a and 220b, modified to serve for the control of a carriage as illustrated in Figs. 3 and 4. This carriage has a single drive motor 20 for both drive devices of traction wheels 6a, 6b. It is connected directly between earth and bus bar 41 which is again energized from the negative terminal of battery 40 via switch 12 of the rapid stopping device. As in the preceding embodiment, the switches for the possible reversal of the motor and connecting it to an alternate control circuit have not been illustrated.

In Fig. 7 the driving relays 120a, 120b have been each provided with a second armature to control both the clutch portions 27a, 27b and the brake portions 28a, 28b of the associated electromagnetic transmission devices 26a, 26b (cf. Fig. 4). When energized, relay 120a or 120b operates the clutch 27a or 27b to power the corresponding traction wheel 6a or 6b. In its unoperated state, relay 120a connects via its right-hand armature and rest contact the brake 28a to the inner left-hand armature of relay 220a whose working contact is linked to bus bar 41; thus, brake 28a becomes effective only with relay 120a released and relay 220a energized. In like manner, unoperated relay 120b connects via its left-hand armature and rest contact the brake 28b to the inner right-hand armature of relay 220b whose working contact is linked to bus bar 41 whereby the brake 28b is actuated only when the unoperated state of relay 120b coincides with the energized condition of relay 220b. Thus, the operation of this system is analogous to that of the system of Fig. 6 inasmuch as either traction wheel, when nondriven, idles on straightforward steering but is braked when the corresponding control 220a or 220b has been set for turning to one side or the other.

Once again, the rest contacts of relays 120a and 120b could be permanently connected to bus bar 41 if a nondriven drive wheel is to be invariably braked.

Fig. 8 shows details of a sensing head 23a. The remaining sensing heads in Fig. 6 are identical. The sensing head 23a has a sensor 23aA and is connected to a relay 223A of the control means. Sensor 23aA is a conductive plate located a short distance above an earthed conductive guide strip 17A to form therewith a capacitor connected in parallel with an inductance 43A as part

of a resonant circuit in the feedback path of a high-frequency oscillator 44A. Upon disalignment of plate 23A with conductive strip 17A, the parallel capacitance is greatly
 5 reduced as the sensor faces only the non-conductive floor beneath it; this results in a sharp detuning or a complete deactivation of the oscillator 44A. When, however, the sensor plate 23A registers with strip 17A,
 10 oscillator 44A has an operating frequency in the pass band of a band-pass filter 45A whose output, after rectification at a diode network 46A, energizes the corresponding sensing relay here designated 223A.

15 Fig. 9 shows a broadly similar sensing head 23B whose sensor 23aB is a length of horizontal wire closely spaced from a highly permeable guide strip 17B so as to introduce a supplemental inductance into a resonant
 20 circuit of a high-frequency oscillator 44B, this resonant circuit including a coil 43B and a capacitor 47B in series with the wire. As before, the absence of the guide strip detunes the oscillator 44B which otherwise
 25 operates at a frequency passed by a band filter 45B to actuate a sensing relay 223B after rectification at 46B.

The arrangements illustrated in Figs. 8 and 9 are representative of a variety of
 30 ways in which a sensor may capacitively or inductively detect the proximity of an electrically conductive and/or ferromagnetic guide strip by modifying the reactance of a circuit controlling the operating frequency
 35 of an oscillator. However, the guide strip can also be sensed according to other methods e.g. photo-electric receivers for a reflected light beam. However, this is more complicated and more liable to faults due to
 40 the danger of contamination. Similar capacitive, inductive or optical circuit elements may also be used as reading elements, in lieu of the magnetic switches
 45 and in particular at the V-junctions. Thus, as when sensing the guide strip proximity switches can be used. Naturally, the electromagnetic relays shown in Figs. 6-9 could be replaced by equivalent electronic circuitry.

50 A number of other advantageous embodiments are possible. It is particularly advantageous if the carriage has an arrangement of traction wheels 6a, 6b and freely swivelable wheels 5c, 5d according to Fig.
 55 3 and a sensing means 21 as well as drive devices for the traction wheels according to the embodiment of Fig. 2. The traction wheels are then in the centre of the vehicle and the sensing means is positioned between
 60 the drive wheels and symmetrically to a vertical plane passing through the axis of the traction wheels. This construction provides a particularly effective steering of the carriage, whereby the same sensing means
 65 can be used for the guide strip without

any reversals both for forward and rearward travel of the carriage. This carriage is particularly manoeuvrable and permits travel
 70 over route paths wherein the guide strip turns at particularly sharp angles. Depending on the arrangement of the code markings along the route path and the reading means on the carriage, the latter can be located in the area of the traction wheels. If
 75 necessary however the reading means may have to be arranged at a distance from the sensing means.

The sensing means, unlike in the embodiments shown, can be equipped with a central sensing head having only one sensor, as is
 80 the case with the outer sensing heads. The sensors are then appropriately located in a row at right angles to the direction of travel. The lateral spacing between sensors is then preferably relatively small.

85 The steering of the carriage then takes place by changing the rotation speeds of the traction wheels. This can be carried out as described hereinbefore. It is also possible in order to obtain the relative speed difference to permit one wheel to be driven in
 90 an unchanged manner but to increase the driving speed of the other traction wheel. Furthermore, such an arrangement makes both active and passive steering possible. In
 95 passive steering only that traction wheel is braked or stopped about which the carriage is to be swivelled. In active steering on deviation of the carriage from the guide strip the drive devices of the carriage are firstly
 100 stopped and only the drive of the wheel on the outside of the turn is engaged. Modifying the carriage according to Figs. 3, 4 and 7 it can be appropriate to connect the electromotor 20 via a differential gear with
 105 the transmission devices of the drive devices of the left and right traction wheel. In this case it is not necessary for the transmission devices to have clutches. It is sufficient if each drive device has a brake which can
 110 be operated by the sensing means via the control means. It is further particularly preferred if the drive motors are permanently energised and can be braked by short-circuiting. Self-locking gears are also suitable
 115 as brakes for the drive devices of the traction wheels.

In place of the reading means of the carriage as described and represented in the exemplified embodiments it is particularly
 120 advantageous to provide the transportation system with a destination indication, as for example described in Patent Specification No. 1 190 211. Each V-junction has then a specific code marking designating the
 125 junction number and the reading means of the carriage has at least one group of reading elements responding to the marking points of the code markings corresponding to the possible junction code markings. The
 130

junction code markings are preferably based on the decimal system. On the carriage can be connected in a ready-to-receive state the reading element of the reading means corresponding to a destination code. With a total or partial agreement of the code markings of the V-junctions with those of the reading means an active steering pulse is supplied to the carriage control means. As a result of the destination code set on the reading means of the carriage and the code markings of the junction, the route to be taken by the carriage at every junction is determined unequivocally and uniformly at any point in the transportation system.

The carriage control means can also be equipped with a floor coding device having a number of generator elements corresponding to the number of marking points of the possible floor destination code, whereof the generator element corresponding to a particular floor destination code can always be connected in. The floor destination code acts on a reading device of a lift system and thereby controls the lift which is included in the transportation system and in which the carriage can travel. The final destination code can therefore comprise a branching point destination code and a floor destination code.

Further possibilities exist regarding the control of the carriage at the V-junctions. Thus, the guide strip of both the straight ahead path and the branching path can be interrupted at the junction. When the code set on the reading means partly or totally agrees with the code marking of the junction, the carriage can receive a positive steering pulse and diverge outwards. It then travels a certain distance without a guide strip, e.g. not be driven, until it again makes contact with the guide strip. If the code marking gives no control pulse to the carriage then the latter passes over the junction, e.g. also possibly not driven, until it is in contact with the guide strip.

Advantageous control of the carriage at the V-junctions is also brought about if only one of the guide strips branching off at the junction is interrupted, i.e. starts at a spacing from the junction. Two possibilities then exist, in the first the straight ahead guide strip is continuous and the branching off guide strip is interrupted. In the case of the total or partial agreement of the code marking of the V-junction with the destination code yet this leads to a temporary disconnection of the sensing means and to a positive diverging movement of the carriage. However, the other possibility is preferable, whereby the straight ahead guide strip is interrupted, in which case the carriage control can take place in such a way that with a partial or total agreement of the code marking of the V-junction with the

carriage destination code the sensing means for the guide strip is simply cut out, whereby the carriage can no longer follow the branching guide strip and instead travels straight ahead. It is then no longer necessary to give the carriage a positive steering pulse.

WHAT WE CLAIM IS:—

1. A carriage including two laterally spaced traction wheels and track sensing means adapted to sense a track without contracting the same, for use in an automatic transportation system including a track sensible by said sensing means, said sensing means comprising a central sensing device situated substantially on the longitudinal centre-line of the carriage, and two lateral sensing devices situated one on each side of said centre-line, said central sensing device being operative, upon sensing said track in use, to cause the said traction wheels to rotate at the same speed and each of the said lateral sensing devices being operative, upon sensing the track in use, to cause the said traction wheels to rotate at mutually different speeds, in such manner as to steer the carriage along the track.

2. A carriage as claimed in claim 1, wherein the said sensing means is situated between the centre of the length of the carriage and one end thereof, for steering the carriage along said track with said one end leading.

3. A carriage as claimed in claim 2, including a second sensing means similar to the first-mentioned sensing means, said second sensing means being situated between the centre of the length of the carriage and the other end thereof, for steering the carriage along said track with said other end leading, only one of said sensing means being operative at any time.

4. A carriage as claimed in claim 1, wherein the said traction wheels are substantially coaxial and are situated substantially at the centre of the length of the carriage, and the said sensing means is situated in the region between the said wheels, for steering the carriage along said track with either end of the carriage leading.

5. A carriage as claimed in any of the preceding claims, wherein the said sensing devices of the or each sensing means are arranged in a row substantially at right angles to the longitudinal centre-line of the carriage.

6. A carriage as claimed in any of claims 1 to 4, wherein in the or each sensing means the lateral sensing devices each comprise only one sensor which sensors are arranged on an imaginary line perpendicular to the longitudinal centre-line of the carriage and are spaced equal distances from said centre-line, whilst the said central sensing device comprises two sensors which are spaced from one another along the said centre-line

and are spaced equal distances from said imaginary line.

7. A carriage for use in an automatic transportation system, substantially as hereinbefore described with reference to Figures 1, 2, 6 and 8 of the accompanying drawings.

8. A carriage as claimed in claim 7 but modified substantially as hereinbefore described with reference to Figure 9 of the accompanying drawings.

9. A carriage as claimed in claim 7 but modified substantially as hereinbefore described with reference to Figures 3, 4 and 7 of the accompanying drawings.

10. An automatic transportation system comprising at least one carriage as claimed in any of claims 1 to 9, and a track sensible by the sensing means of the or each said carriage.

11. A system as claimed in claim 10, wherein the said lateral sensing devices of the or each sensing means of the or each carriage are spaced apart by a distance which is substantially twice the width of the said

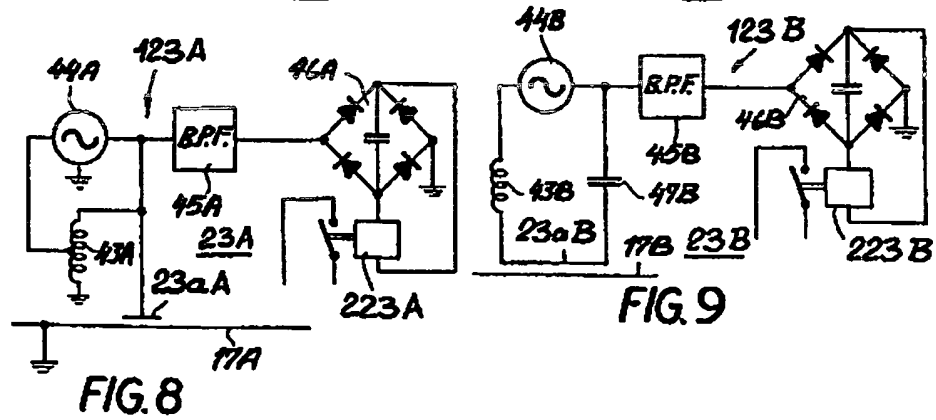
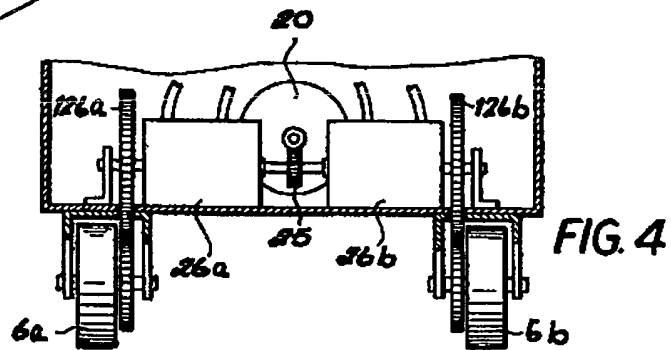
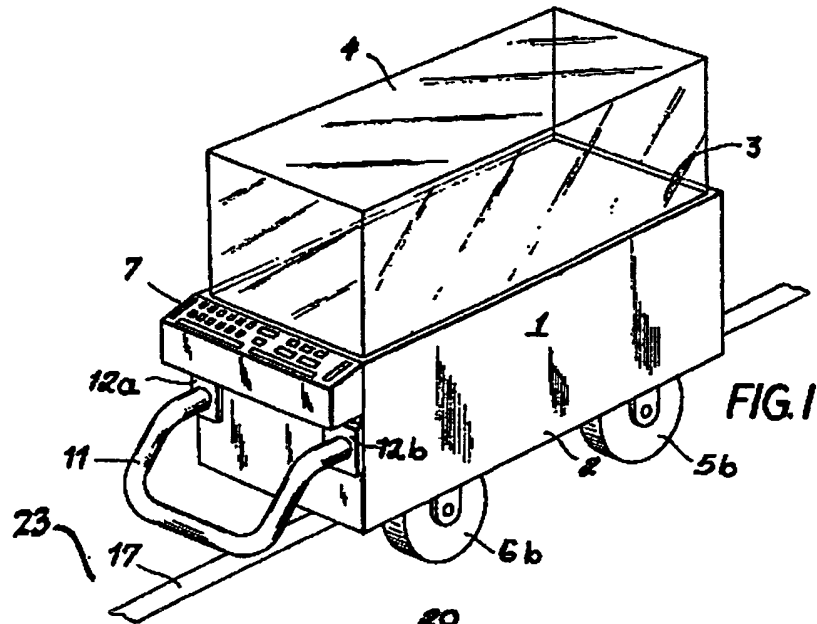
track.

12. A system as claimed in claim 10 or 11, wherein the or each said sensing device of the or each said carriage includes at least one oscillator connected in a circuit which, in operation, includes the said track and the impedance of which circuit is such that, when the oscillator faces the track, oscillations take place in said circuit.

13. A system as claimed in claim 12, wherein the or each said circuit has a filter at its output arranged to cause a control signal to be generated when oscillations take place in the circuit.

14. A system as claimed in any of claims 10 to 13, which includes a track portion substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.

For the Applicants,
FRANK B. DEHN & CO.,
Chartered Patent Agents,
Imperial House, 15-19 Kingsway,
London, WC2B 6UZ.



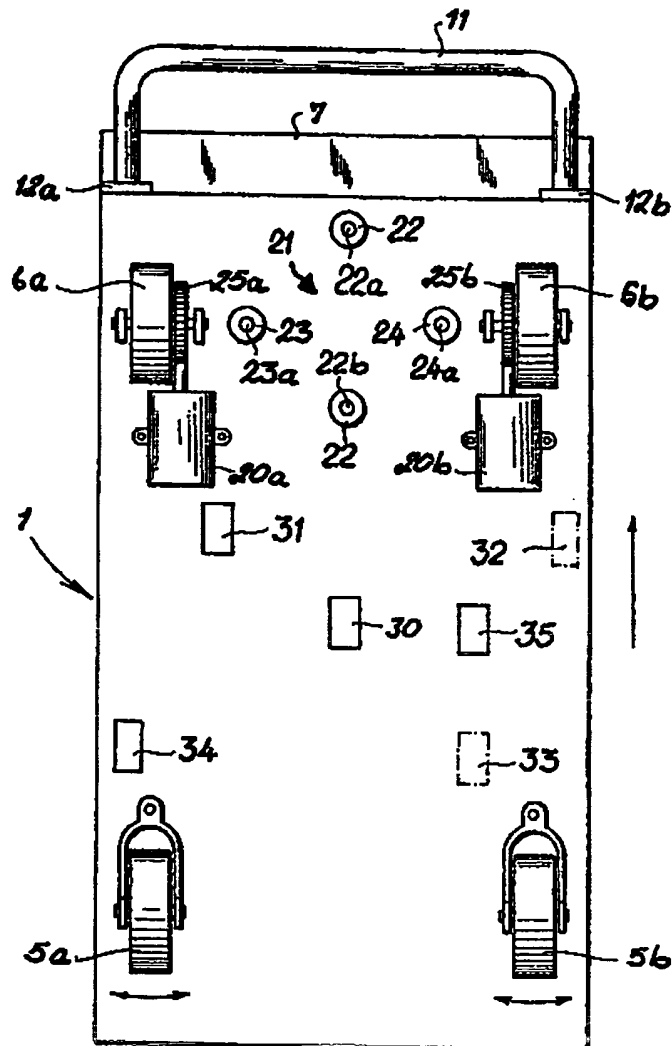
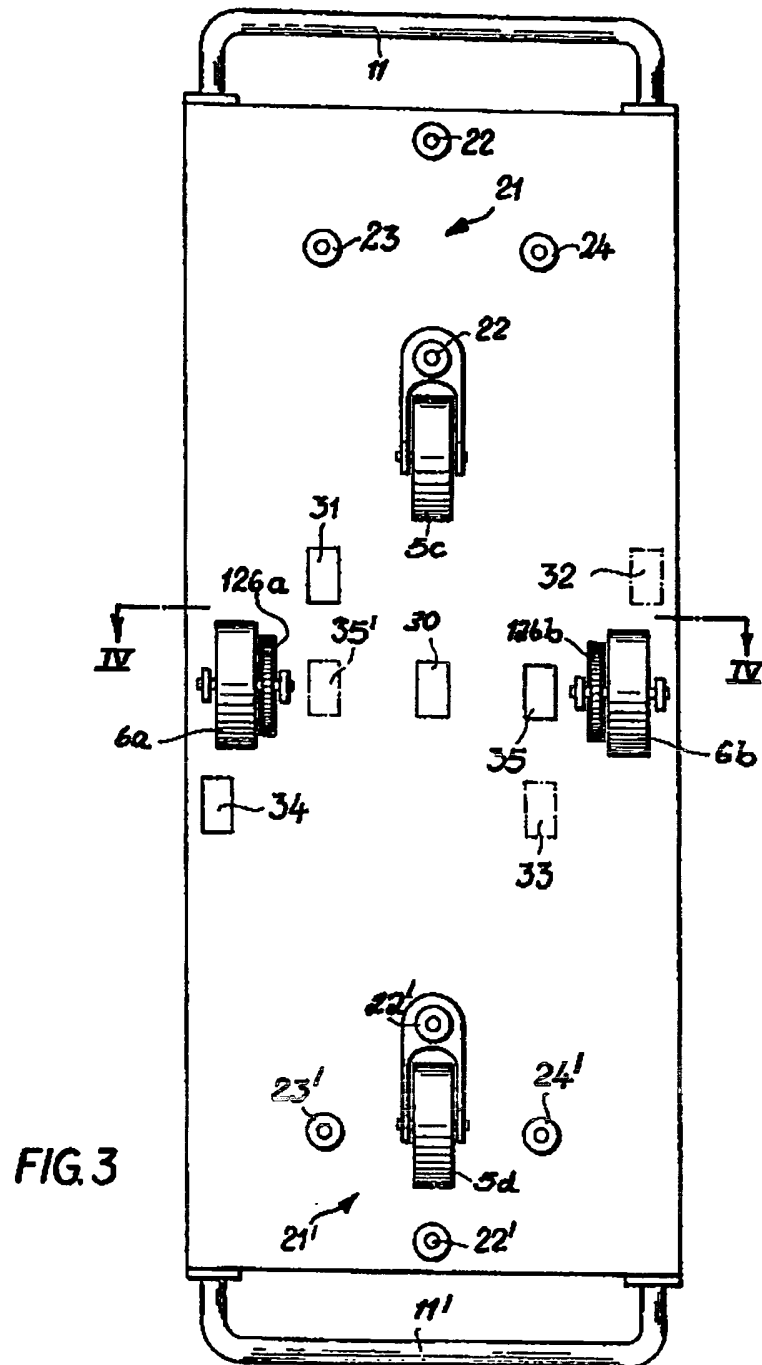
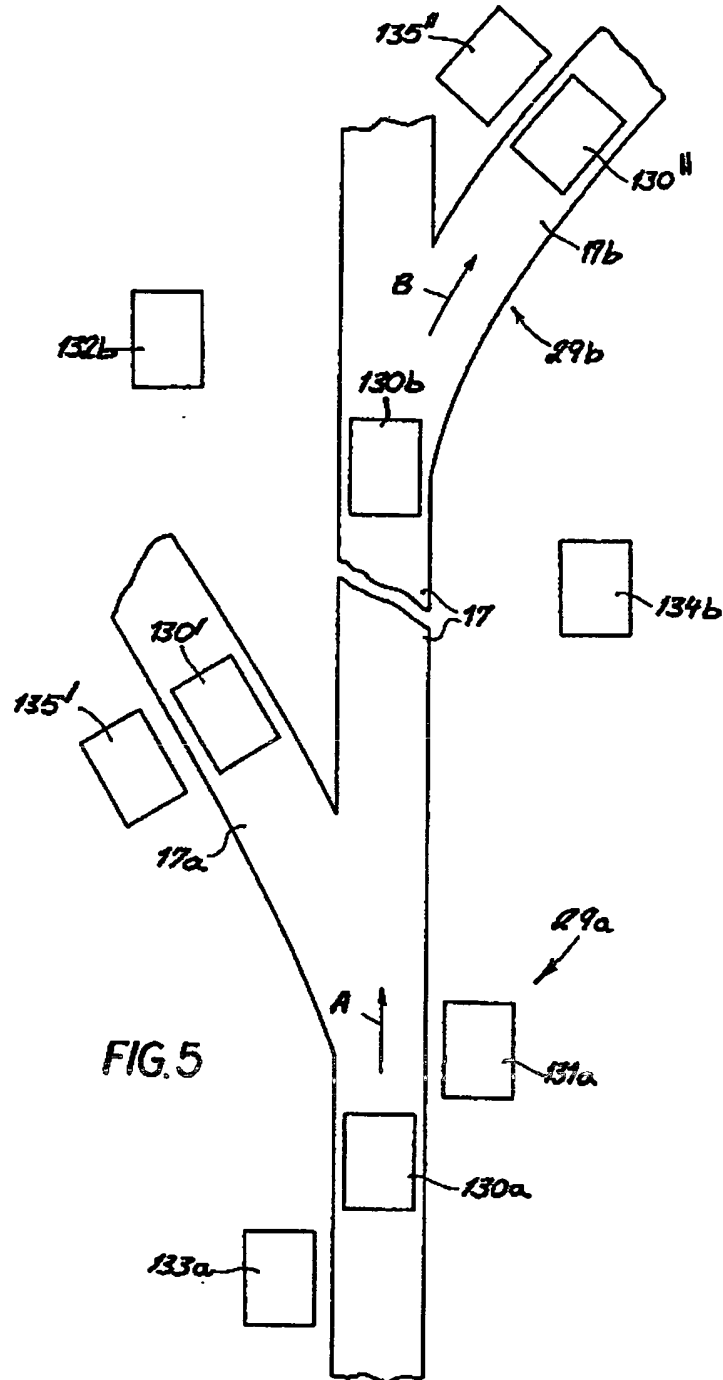


FIG. 2





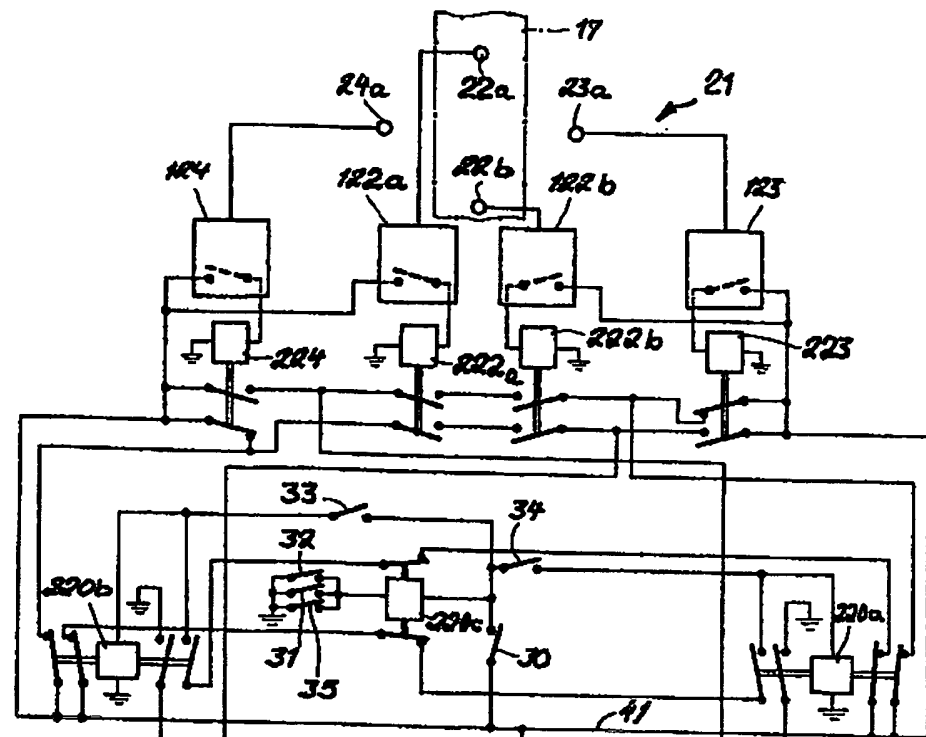


FIG. 6

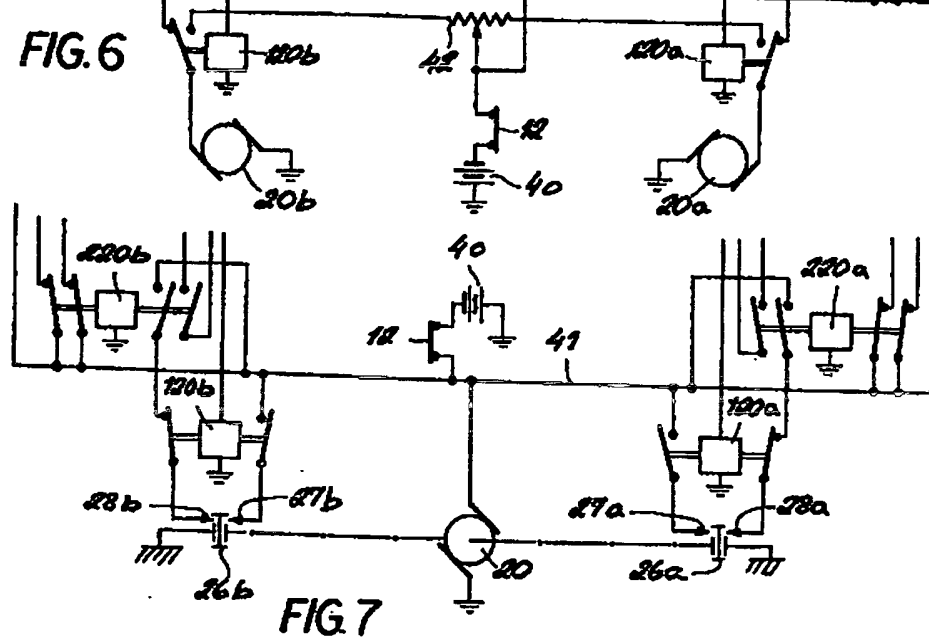


FIG. 7